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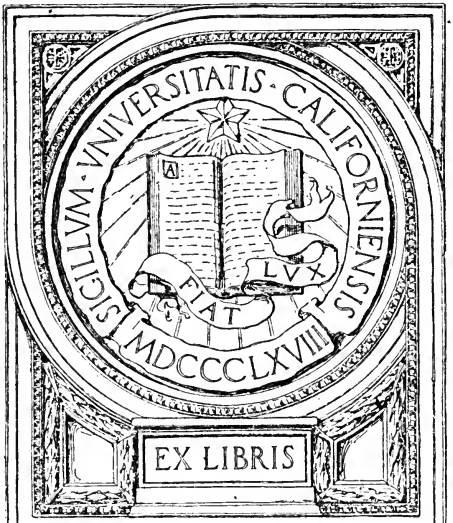
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AUGUST 1919

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SOME HOT SPRINGS OF SOUTHERN CALIFORNIA

By

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University of Southern California

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Their Origin and Classification

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1919
UNIVERSITY OF SOUTHERN CALIFORNIA PRESS
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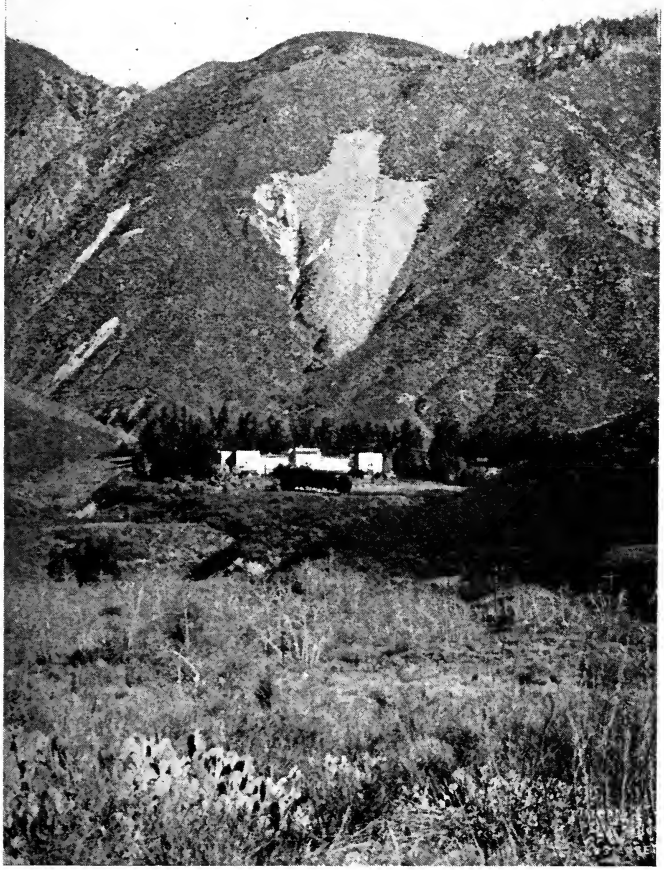

ARROWHEAD MOUNTAIN

The Fault Belt crosses the flat ground between the Arrowhead Hotel and the natural Arrowhead on the Mountain

SOME HOT SPRINGS OF SOUTHERN CALIFORNIA

Their Origin and Classification

California has more mineral springs of commercial value than any other equal area in the world.

They are one of the greatest assets of the State. Many of them are just as valuable as the most noted Spas in Europe. Some of them have such a special value that they should be taken over by the Government so that their benefits could be enjoyed by the masses instead of by the wealthy only.

Now is the time to let the world know the facts about these springs, for travel to the Spas of foreign lands will be restricted for some years to come, and the tide may and should be turned this way.

Fault Lines and Hot Springs Related. An examination of a map that shows both the fault lines and the hot springs brings out clearly the fact that the two are related.

California mountains in general are the result of crustal movements. Many individual ranges are the result of local uplift, and the basin type of valley is also very common.

The faults, or fissures, have great depth as compared to their width; they are very persistent, often being traced for miles on the surface; and they cut across formations of all kinds, and displace strata.

A Fault Belt 800 Miles Long. A great structural fault belt starts at Tejon Pass and runs in a straight line to San Francisco, thence is follows the coast to Cape Mendocino where it disappears under the ocean. This is known as the *ANDREAS FAULT* line or belt; and it is the one that caused the San Francisco earthquake in 1906. Starting again at Tejon Pass this same fault belt has been followed southeast across the Antelope Valley to the Sierra Madre Range. It follows the north side of this range to Cajon Pass. It forms that Pass, and gives a channel to Lytle Creek. At the lower end of the Pass the fault runs at the base of the San Bernardino Range, past Arrowhead Hot Springs, and on to San Gorgonio Pass; and thence on to

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Salton Sea. This Andreas-Cajon Fault has been traced and mapped for a distance of nearly 800 miles. It has been the scene of several local earthquakes along the line in the last 150 years.

The great *Sierra fault* line starts also at Tejon Pass and follows the eastern base of the Sierra Nevadas from Kern county to Inyo, and thence to Plumas county.

The Cascade Range, the Klamath Range, and Mount Lassen all have shorter fault lines.

Each major fault is accompanied by minor faults that are generally parallel to the main fault.

Hot Springs Are Related to the Faults. The Hot Springs of the southern part of the State lay between the Andreas-Cajon fault and the ocean. North of Santa Cruz county they lie east of the Andreas fault. A belt of hot springs accompanies the Sierra fault from Inyo to Plumas county. The north end of the State has hot springs along local fault lines. A very few hot springs are found outside of the belts mentioned, and then only on or near local fault lines. (See Plate 1).

An Important Fact. If the waters rise from a fault belt that is a marked feature in the geologic history and mountain building of California, that fact is of commercial importance, as:

A. If the fault, or fissure, is in granite or other igneous rock:—

1. It may be miles in depth, and the waters may be *Juvenile* waters that see the light of day for the first time in untold centuries.
2. That the water supply comes from the depths of the earth and is *not dependent* upon nor affected by the rainfall of the region.
3. That the water is very liable to be radio-active.
4. That the waters are liable to contain rare and beneficial elements not found in vadose waters.

B. If the waters start upward from a fault, but pass later on through sedimentary rocks; then the waters will show that fact and be charged more or less with the minerals from the sediments.

C. If the waters become mixed with ground waters, the flow is affected by local rainfall; and the value of the waters may be injured, or lessened in value.

Juvenile Waters. Modern investigation, especially in Europe, into the waters of metaliferous veins, volcanic waters, magmatic waters, and the waters of prominent Spas like Carlsbad, has led to the discrimination between waters of superficial

origin (*vadose* waters), and those of deep-seated origin or juvenile waters.

The magmatic waters are carriers of metallic salts by which certain metal bearing faults (*veins*) are filled; and the contents of such veins are notable for the absence of oxidized products except in the upper part near the surface.

Granite heated in vacuo gives off water and gases identical with volcanic gases. Refined analysis of igneous rocks show that they contain the rare elements as—titanium, zirconium, strontium, chromium, lithium, thorium, boron and others.

Suess has shown that the hot springs of Carlsbad issue from the fundamental magma itself and bring veritable additions to hydrosphere.

The geologic evidence is strong that many of the springs of California are fed by magmatic waters. It would be "good advertising" to thoroughly demonstrate this fact. It would "pay" to prove beyond question that the springs here are quite as *unique* in their origin as the most celebrated one abroad.

Identifying Juvenile Waters. The Juvenile, or virgin waters, may be identified by several characteristic features. They are:

1. Constant in composition from year to year.
2. They are constant in concentration from year to year.
3. They are constant in rate of flow from year to year and are unaffected by local rainfall.
4. They contain certain elements that are known as "deep minerals," and volcanic emanations as:—arsenic, boron, nitrogen, sulphides, hydrocarbons, rare metals and others.
5. They are thermal; and constant in temperature.
6. They often show increased flow (or the reverse) at the time of local earthquakes.
7. They often show an increase in temperature at the time of local earthquakes.

Temperature and pressure work together. The temperature is of great importance in waters that contain gases. A high temperature alone may be the result of local chemical reactions; but *temperature and pressure* combined with *fault lines* and igneous rock point to the existence of juvenile waters.

Vadose Waters, or superficial waters sinking into the ground from rainfall, fluctuate in composition, concentration, rate of flow, temperature; and contain as a rule sulphates, chlorides, and carbonates of lime and magnesia.

Intermediate Waters. These may represent the mixture of vadose water with juvenile water.

The Cajon Fault Zone. This belt or zone, of parallel faults affords an excellent opportunity to study the origin of the hot springs. After passing along the north edge of the Sierra Madre it forms Cajon Pass. At the south end of this Pass the fault belt divides into three parts; (1) The main fault line; (2) the San Jacinto Fault; (3) the Elsinore Fault; and each is accompanied by groups of hot springs.

The Main Fault. The famous Arrowhead Hot Springs are on the main Cajon fault, near the base of the San Bernardino range, and a few miles east of the mouth of Cajon Pass. Over 100 springs are known in the "Hot Belt" which extends from the Hotel beneath the Arrowhead, to Waterman Canyon on the west, a distance of about a mile. The "belt" is as wide and nearly twice as long as the famous "strip" at the Arkansas Hot Springs. The formation is granodiorite and gneissoid rocks, with some diorite porphyry. The "Caves" at the west end in Waterman Canyon are in the conglomerate rock that overlies the gneissoid rock. The *natural steam* and the hot waters rise through this boulder conglomerate, filling the caves. Penyugal Springs flow from a fissure in the granite in Hot Water Canyon, near the east end of the "belt," and has a temperature of 202 F. Going east from Arrowhead the Cajon fault forms the San Gorgonio Pass and runs along the north side of the San Jacinto range to Salton Sea. At the northern base of San Jacinto Range is Palm Springs (Aguas Calientes of the Indians). It issues from the granite wash of the valley, at a point nearly 150 feet below sea level. The temperature of the springs is a little over 100 F. Southeast of Palm Springs on the course of the same fault are the Mud Volcanoes on the east side of the Salton Sea. These are hot springs that build cones of the blue mud, and deposit some sulphur. The temperature is about 190 F. There are three other minor springs on the Cajon Fault but I have not visited them and have no accurate data.

The San Jacinto Fault. This fault branches from the Cajon at the mouth of Lytle Creek and runs south to Bunker Hill near San Bernardino, there it turns and runs nearly parallel to the major fault in the direction of the towns of San Jacinto and Hemet. The Eden Hot Springs are on this fault. They issue from granite and have a temperature of 110 F. The Tertiary shales and sandstone of the "Bad Lands" outcrop close to these springs but the waters are *not* affected by them. The San Jacinto Hot Springs (Relief Hot Springs) are about six miles east of Eden. Here, half a dozen springs issue from the granitic alluvium; the Ritchey Hot Springs are about five miles farther on, at the base of the range. They are in gneiss and have a temperature of 82. F.

Wells. Between the Cajon and the San Jacinto fault lies the San Bernardino Valley. In this valley thermal waters have been found in a number of wells drilled into the alluvium. Harlem Hot Springs and Urbita Hot Springs are examples; the temperature ranging from 106 to 90 F. The abundance of the thermal waters in the valley filling can only be explained as coming from a common source, namely the fault lines.

Elsinore Fault Line. The Elsinore fault is nearly parallel to the San Jacinto fault. It runs through Elsinore Lake and north to the Temescal Canyon, and south to Murietta. The Glen Ivy Hot Springs are in Granite porphyry, and have a temperature of 102 F. At Elsinore, wells have been drilled in the aluvium where the fault line leaves the lake and obtain water having a temperature of 112 F. At Murietta, hot springs rise in granitic gravel covered by Quaternary gravels, and have a temperature of 136 F. The Warner Hot Springs flow from half a dozen vents in the granite, and have a temperature of 139 F.

Are Any of the Waters Juvenile? What is the evidence?

First—RATE OF FLOW. The records of the rainfall have been kept for many years at San Bernardino, San Jacinto, Elsinore, Warner and other places in the area covered by this paper. The variations are from heavy to light rainfall in the different years. If one draws curves showing the precipitation from month to month and from year to year; and plats the flow of the springs for the same time; it is at once evident that there is *no connection between* the two in the case of Arrowhead, San Jacinto, Palm, Warner, and the Mud Volcanoes. Here the rate of flow is *unaffected* by the precipitation so far as one can see from the records. The flow from the hot springs has been uniform and constant, with no period of increase or decrease. This is in marked contrast to the cold water springs of the region. At Penyugal a cold spring flows side by side with the hot waters for a ways, giving opportunity for direct comparison.

Each of the hot springs of the area have been affected by the earthquakes that have caused this region to tremble at various times in the last 150 years; some of them in the last 50 years. The furious boiling of the mud springs at Arrowhead in 1812 "the year of the earthquakes" or "El ano de las Temblores" as the Spaniards called it; and the Mud Volcanoes at Salton Sea are matters of record. The flow however has not been markedly affected except an increase during the period of the quake, and after that it was normal again. This can only mean *deep-seated*

waters that have their origin in the depths, miles below the surface.

Where the waters rise through alluvium or sedimentary rocks, or through pipes sunk into the alluvium of the Valley, there is a fluctuation naturally. In such cases while the waters may come from fissures buried beneath the alluvium, and the hot waters follow openings in the valley filling, they must necessarily mingle with the waters of the rainfall.

Second—CONSTANT IN CONCENTRATION. Here we are hampered by the fact that only "commercial" analyses are available for most of the hot springs. However, good analyses of Arrowhead Hot Springs extend back to Lieutenant Wheeler's Report, U. S. A., in 1876. There have been many since that time both by individuals and by the Government. These Springs are also *unique* in the fact that they are the *only* hot springs ever analyzed by the French Government; and that was on account of the reported arsenic present. These records show no marked changes in the amounts and nature of the salts present; but on the contrary they are remarkably uniform when we take into account the advances that have been made in methods of analysis in that time.

The deposits at the Mud Volcanoes at Salton Sea of blue mud, and of sulphur, show no changes for ages. The analyses at Warner Hot Springs extend nearly as far back as those of Arrowhead, and they also show no recognizable changes.

Third—THE RARE ELEMENTS. Only the Arrowhead and Warner Hot Springs have any *adequate* analyses of their waters. Several elements indicate that the waters are Juvenile and come from the depths. The waters of Arrowhead are radio-active. The amount of silica in all the hot waters, along the faults, is unusually large. At Arrowhead there are old deposits of white siliceous matter near the "Hot Belt" that have been deposited apparently by hot waters in former ages. A strong proof of the juvenile character of the waters is found in the presence of the rare element boron. This element occurs at Arrowhead, Mud Volcanoes, San Jacinto and Warner Hot Springs (and probably will be found at the other springs when looked for). This element is found in the hot waters of volcanoes, fumeroles and magmatic waters, and is a fair indicator of juvenile waters. The arsenic in the waters and in the steam of the "caves" at Arrowhead is another indicator. Lithium, strontium, sulphur, and phosphorous, corroborate this view. The absence of nitrogen, carbon, bromine, iodine, and barium are also evidence that the waters are not vadose.

At Elsinore, Urbita, Harlem and others, where the waters rise through pipes of bored wells, the waters probably are mainly vadose, with some juvenile waters intermingled.

Fourth—TEMPERATURE. The temperature of the hot springs comes from deep in the earth, from magmas, or, from igneous rocks that are slowly cooling. That the heat is *not* caused by chemical reactions near the surface is evident to every chemist. If it was of surface origin the nature of the waters would be entirely different.

The following shows the temperature of the principal hot springs of the State, so far as I have accurate records:

Temperature above 190 *F.* Arrowhead 202; Casa Diablo, Mono Co., 194; Kelleys Hot Springs, Modoc Co., 199; Sespe Creek Hot Springs, Ventura Co., 191.

Temperature 190 *to* 170 *F.* Bassetts, Lassen Co., 173; Amedee, Lassen Co., 172; Tartarus, Plumas Co., 170; Isle in Mono Lake, 176.

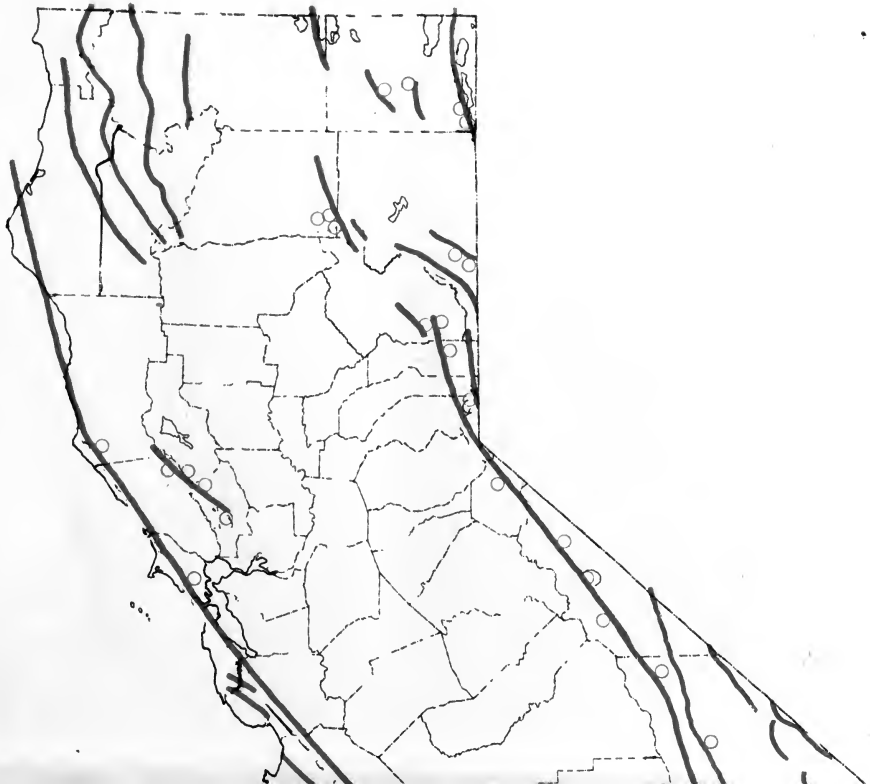
Temperature 170 *to* 140 *F.* Big Bend, Shasta Co., 165; Stonebreaker, Lassen Co., 166; Castle, Lake Co., 164; Marble, Plumas Co., 161; Klamath, Siskiyou Co., 156; Bridgeport, Mono Co., 148; Drake, Plumas Co., 148; Grover, Alpine Co., 146; Anderson, Lake Co., 146; and Fales, Mono Co., 141.

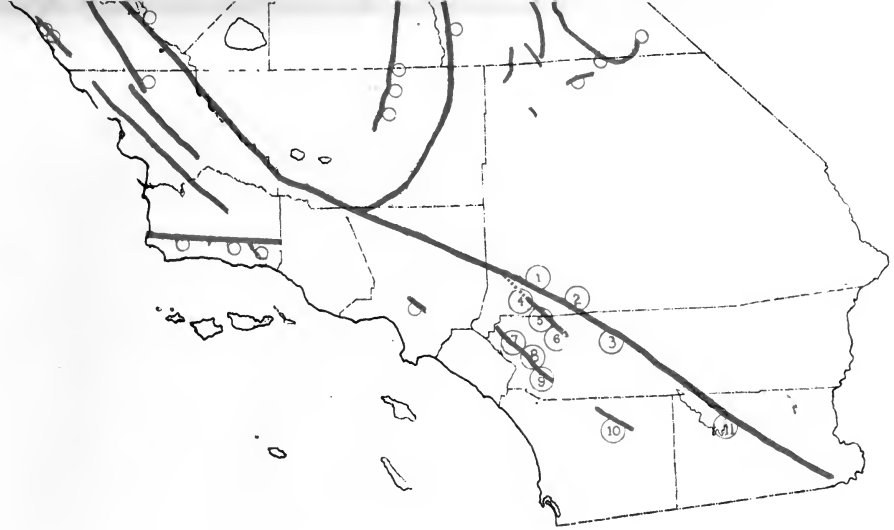
Temperature 140 *to* 110 *F.* Tassajara, Monterey Co., 140; Wilbur, Colusa Co., 140; Buckeye, Mono Co., 140; Warner, San Diego Co., 139; Murietta, Riverside Co., 136; Neils, Kern Co., 131.

Temperature 110 *to* 90 *F.* Riverside Co.; Palm, 110; Ritchey, 111; Elsinore, 112; Eden, 110; Glen Ivy, 102; Urbita in San Bernardino Co., 106 and over 100 other hot springs in the State.

There is a remarkable uniformity in the temperature of the last springs mentioned when the fact is considered that they all belong to the same topography as described further on.

Topography of the Area. A study of the topography of the area of the hot springs on the Cajon, San Jacinto, Elsinore, and Warner Faults, shows a remarkable and interesting fact. If one draws a line from Riverside to San Jacinto, thence south to Warner, and thence back to Elsinore and Riverside, the triangle formed is part of the *old topography* that remains very much in the condition that it was in the Tertiary times; also that this area was at one time *a part of the plains* that still exist on the





MAP SHOWING MAIN FAULT LINES

1. Waterman Steam Caves
2. Arrowhead Springs
3. Palm Springs
4. Eden Hot Springs
5. Relief Hot Springs
6. Ritchey Hot Springs
7. Glen Ivy Hot Springs
8. Elsinore Hot Springs
9. Murietta Hot Springs
10. Warner Hot Springs
11. Mud Volcanoes

summit of the San Bernardino Range. This explains why the temperatures of the springs on these plains are very much the same. In order to understand why this ancient topography still exists one must know something about how and when the Range was formed.

Birth of the San Bernardino Range. (1) This range like the other Sierras of the State was born at the end of the Jurassic period.

(2). It was worn down by erosion during succeeding epochs.

(3). In the middle Miocene trouble began again, the Range was again elevated.

(4). In the late Tertiary the Range was *much lower* than it is now. It was worn down by the elements almost to the condition of a plane with isolated peaks jutting up through the nearly level valleys. The topography at that time closely resembled the appearance of the present region around Perris that is known as the San Jacinto plains.

(5). The Range was again uplifted to its present form in the Sierran epoch at the beginning of the Pleistocene.

The Range as a whole represents a great block of the earth crust tilted up, like a great cake of ice, by pressure from the southwest. It is tilted *toward the Pacific Ocean,* caused by a settling of the Ocean bottom.

The San Bernardino valley represents a great depressed area south of the line of fracture in the earth's crust.

This tilting was not done in one gigantic catastrophe, but the growth was a gradual process, the movement was gentle, a few inches or, at the most, a few feet from time to time. The cumulative effect being a mountain range where originally were only *broad plains.*

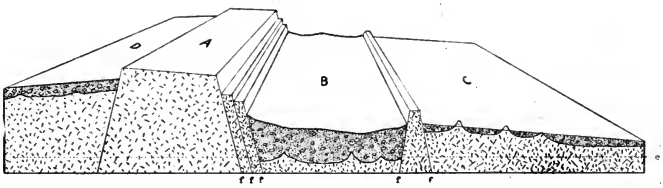
A Young Mountain. Mt. San Bernardino is younger than the San Gabriel mountains. If one stands on Santiago Peak and looks the landscape over, he will see an abundance of evidence.

There are no horizontal lines along the San Gabriel tops, but a confusion of peaks.

But the younger range has a long even skyline at an elevation of 5000 to 6000 feet and the "Rim of the World Road" has taken advantage of it. The San Gabriel mountains are a labyrinth of canyons, ridges and peaks without level areas of any size or streams that are even graded. San Bernardino has many wide upland valleys, grass glades, lakes and plazas. Their very names are suggestive of enjoyment to lovers of nature as: Bear Valley, Green Valley, Fawnskin Valley, Monarch Flat, Pine Flat, Strawberry Flat, the Meadows and a score of others.

The topograhpy is rounded and gentle, the *level areas are ex-*

tensive, the streams meander placidly through broad meadows; and the uplands look like a rolling country of moderate elevation rather than summit lands. As the edge of these interesting uplands is approached the streams plunge into deep and narrow canyons. The slopes are steep. The roads and trails have to wind and twist and use switchbacks to find a way to the bench below.



CROSS SECTION NORTH AND SOUTH

A. San Bernardino Range
B. San Bernardino Valley, or Cucamonga Plains
C. Perris Valley, or San Jacinto Plains
D. Mojave Valley

e. Sea Level
f. Fault Lines

Ancient Topography. All of these facts have a definite meaning. The upland smooth forms are remnants of the landscape of the Tertiary times when this area was a low mountain plain. These fragments of the ancient topography are still preserved practically in the condition in which they existed prior to the present elevation. The smooth uplands were produced by long erosion at lower levels before the Range was re-elevated in the Pleistocene.

When the crustal block tilted and was shoved upward and pressed against the northern edge, these upward areas simply arose to a higher station in life. As the tilted block slopes to the south, the main watershed is to the south also.

A Sunken Valley. When this block was tilted, forming this Range, another block to the south slipped *downward,* forming a valley, the bottom of which was below sea level. This is now known as the *San Bernardino Valley,* or Cucamonga plains.

The erosion of the sloping side of the Range has filled the valley to a depth of probably 3000 feet, so that the city of San Bernardino stands 1200 feet above sea level.

Part of San Jacinto Plains. Perris Valley now so widely separated geographically and in elevation, once formed a con-

tinuous surface with the uplands of the mountain summit; and the sunken Cucamonga Plains was a part of the same surface.

In the changes that took place along the fault line the Perris Valley was raised slightly; the San Bernardino Range was raised much more; and the San Bernardino valley sank until portions of it were below sea level.

Other Crustal Changes. Many other crustal movements occur along this remarkable fault line that are important and worthy of study. For example, a crustal movement lifted a ridge or an irregular arched wrinkle, along the line of the "Bad Lands" which separate San Timoteo Canyon from the San Jacinto Valley. This fold can be traced on the surface to Bunker Hill. It exposed the beds containing rare fossils of the same animals as those of Rancho La Brea, these beds are just north of Eden Hot Springs. This fold also is an important factor affecting artesian wells around San Bernardino.

The Age of the Hot Springs. The waters of the Arrowhead Hot Springs, and of others on these fault lines, began to flow soon after the fissures were formed. In other words the hot springs are as old as the San Bernardino Range itself. That means that the hot springs are older than Niagara Falls, older than the Pyramids of Egypt, older than the Big Trees of the Yosemite, and older than the aboriginal Cave-man. They are just as *permanent* as the mountain itself.

This brief summary of a study of the origin of some of the hot springs of southern California suggests that the geologic study of all the hot springs of the State should be made for the benefit of the people.

It also suggests a re-arrangement of the usual classifications, extending them and making them more useful as:—

FIRST—*The geologic origin of the springs.*

SECOND—*The physical nature of the waters.*

THIRD—*The chemical composition of the waters.*

FOURTH—*The therapeutical value.*

A summary of this kind would make clear what Nature has done. What man has done in the way of accommodations or attractions to persons seeking health is important, but it is really subordinate to the proven value of the waters. A patient seeking health should know the relative *value* of the different waters. Such a clasification as proposed would bring out all of the facts, and the value of the waters could be seen at a glance.

Geologic Facts. The classification should start with a geologic study of the area around the springs; and the first thing to study is the *FAULT LINES* or fissures from which the springs issue.

A CLASSIFICATION OF HOT SPRINGS

First: GEOLOGY

A. Relation to FAULT LINE.
   1. On or near a fault.
   2. Not near fault.

B. IN LAVA. (a) Showing deposits. (b) No deposits.

C. LAVA NEAR BY. (a) Deposits. (b) No deposits.
   1. In granite.
   2. In metamorphic rocks.
   3. In altered sediments.
   4. In unaltered sediments.

D. NO LAVA NEAR BY. (a) Deposits. (b) No deposits.
   1. In granite. 2. Metamorphic rock. 3. Altered sediments. 4. Unaltered.

Second: PHYSICAL

1. Temperature. (a) Hot. (b) Cold.
2. Juvenile waters.
3. Vadose waters.
4. Intermediate waters.

Third: CHEMICAL COMPOSITION

1. Saline. 2. Carbonated. 3. Alkaline. 4. Mixed type.

Fourth: MEDICAL VALUE

DEFECTIVE ANALYSES

The U. S. Government in a recent Bulletin on the Springs had to recalculate nearly every analysis, and reject many because of their evident unreliability.

The ordinary "commercial analysis" of the waters gives the results as so many "grains per gallon" of *combined salts;* such as sodium sulphate for example. Such an analysis is really untrue and misleading and obsolete. Chemistry now shows that there is not only no proof that these combinations are present as "combinations" at all; but offers proof to the contrary. In fact, recording an analysis in this form is *purely hypothetical* guess work, and in all probability untrue and misleading. Such analyses are rejected by the Government and all chemical societies. They are sop to the ignorant. They are of value to only the Doctor who "never cared for chemistry anyhow."

Why not educate the public in the mysteries concealed in a drop of water, and tell him something about the mysterious forces hidden there.

The only up-to-date analysis is the one giving the "ions" in parts per million. If the Doctor is himself, "up-to-date" he can then judge of the *true value* of the waters.

The ordinary analysis only recognizes that which may be precipitated and weighed in quantity on the balances. It leaves out everything else to be reported as a "trace."

These "traces" may be the very thing that gives the waters special value for healing, the true sources of the mysterious power over certain disorders.

For example the "arsenic acid" radicle found at Arrowhead Hot Springs. This is present only in 0.435 parts per million; (or to use the purely hypothetical form and say that it is combined with sodium; "sodium di arsenate, 0.034 grains per gallon). These figures may be thought insignificant, only 0.435 parts in one million parts. Not at all. The French Government took over the arsenic spring of France at La Bourboule in the valley of Dordogne on account of its special value in many diseases; yet the amount present there, is almost the same as in the California spring. The "traces" may be more valuable than the minerals present in quantity.

The spectroscope will recognize all of the "traces" and point out the way to prove their presence by other methods. How many resorts have taken the trouble to have their waters studied with a spectroscope?

The governments of Europe recognized the value of this class of work long ago; for example, at Carlsbad the government gives the list of "ions" present as follows: Chlorine, sulphur, sodium, potassium, magnesium, *fluorine, boron, phos-*

phorous, selenium, tellurium, rhubidium, caesium, arsenic, antimony, zinc, lithium, strontium, calcium, barium, iron, manganese, aluminum, and silicon. Only a few are present in weighable quantity or would have been recognized in a "commercial" analysis; but who can tell what power lies in these "traces." It is also of interest to some that the waters of Arrowhead in our own state resemble in many ways those of Carlsbad.

The analysis of the Carlsbad water and other famous waters emphasizes the futility of any "drug store" imitation or other counterfeit of any mineral springs waters.

Radio-activity has just come into its own. It cannot be caught in a test tube, or seen by the microscope. The electroscope will however measure accurately the few *trillionths* of one percent that exist in a pound of rock or in a *gallon of water.* This delicate instrument has revealed the presence of radium in fresh fallen snow, in soils and in a hundred other unexpected places. It has been found in the Geysers of the Yellowstone Park, in the Hot Springs of Arkansas; and in the Hot Springs and Natural Steam Caves of Arrowhead. A few years ago a "few trillionths of 1 percent" would have been ignored. Today a Radium Institute and Hospital richly endowed is being built here in Los Angeles.

Helium, the new gas that will not burn nor explode, and which is revolutionizing the science of ballooning, was discovered in 1888 in the Sun by the spectroscope. It was found years later in uranium ore. Now it is separated from the other natural gasses at the U. S. Government plant at Fort Worth, Texas, from the Petrolia oil fields.

It is of interest from the fact that when Radium breaks down into emanations the other substance that is formed is Helium. It is now known to exist in springs, volcanoes, and natural gas wells and probably exists at Arrowhead and other springs. Nitrogen exists in vast quantities in the atmosphere as an inert gas which will not combine with anything except by special means. Who can predict what new forces will be revealed when the secret of combined Helium is solved? Who can say now what part it plays in the mineral waters?

I wish to emphasize the necessity of scientific analyses of the waters of our Springs using every means of research available, balances, spectroscope, microscope, electroscope and any other means available.

RARE ELEMENTS. It is necessary to look for and identify the *rare elements especially in California,* for the geologic evidence is that they exist in unusual quantity. The

gem mines of Riverside and San Diego counties are also found along the *fault lines* in the southern part of the State and contain many of the rare elements. Lithium, berrylium, caesium, rhubidium, and a score of others have been found, some of them in notable quantity. The occurrence of large quantities of boron, fluorine, selenium, strontium, tellurium, arsenic, chromium, zirconium and others, in commercial quantity is familiar to you all.

In all probability the minerals reported present in any spring water *falls far short* of the number that *are really present.* The key to finding the rare elements is found in studying the geologic origin of the spring.

ORDINARY ADVERTISING. Resorts spend large sums in talking about location, scenery, society, boulevard, golf, tennis and the "table." They exert themselves to secure some famous Admiral, General, Aviator or Hero of the Movies, or other Lion of the Hour as a guest. That is right and proper in its way; but why stop there? It is NOT up to-date advertising.

THE HOT SPRINGS OF CALIFORNIA ARE ONE OF THE BIG ASSETS OF THE STATE. Why not advertise that fact in a way to carry conviction? Why not PROVE IT in such a way that the World will "sit up and take notice."

NOW IS THE TIME, for travel to the Springs of Europe will be hampered for the next few years.

When the Public realize the facts and know that they are the facts, the crowds that spend millions abroad will turn to this State.

UP-TO-DATE ADVERTISING. Every reader of the leading magazines has noticed a radical change in the advertizing of the big men, the leaders. They now use the printer's ink to *educate the people.* They secure their confidence and respect by showing all their processes; by telling exactly what they do and why. It is not sufficient to say "these goods are the best" for the people say, "prove it," "explain it to me so that I may understand." The Big Men realize that their customers are quick to pick up the *good points,* and that a satisfied customer first becomes a friend and then a booster.

Why not apply this principle in advertizing the Hot Springs? Take the people into your confidence. Tell them all about the origin of the water. Explain the difference in origin of the waters. Explain the methods of finding out the truth. Explain what are the essential facts and why. Do this without fear or favor.

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